

## WHAT IS CLAIMED IS:

- 1 1. A Nd-Fe-B type rare earth magnet alloy comprising:  
2 hard magnetic phases and soft magnetic phases;  
3 wherein a minimum width of the soft magnetic phases  
4 is smaller than or equal to 1  $\mu\text{m}$  and a minimum distance  
5 between the soft magnetic phases is greater than or equal  
6 to 0.1  $\mu\text{m}$ .
  
- 1 2. The Nd-Fe-B type rare earth magnet alloy as claimed in  
2 claim 1, wherein a composition of the Nd-Fe-B type rare  
3 earth magnet alloy is expressed by the following chemical  
4 formula (1)  
5 
$$\text{Nd}_x\text{Fe}_{100-x-y-z}\text{B}_y\text{V}_z \quad \text{---(1)}$$
  
6 where x is within a range from 9 to 11, y is within a range  
7 from 5 to 8 and z is within a range from 0 to 2.
  
- 1 3. The Nd-Fe-B type rare earth magnet alloy as claimed in  
2 claim 2, wherein 0.01 to 80 atom% of Nd is replaced with Pr.
  
- 1 4. The Nd-Fe-B type rare earth magnet alloy as claimed in  
2 claim 2, wherein 0.01 to 10 atom% of Nd is replaced with Dy  
3 or Tb.
  
- 1 5. The Nd-Fe-B type rare earth magnet alloy as claimed in  
2 claim 2, wherein 0.01 to 30 atom% of Fe is replaced with Co.
  
- 1 6. The Nd-Fe-B type rare earth magnet alloy as claimed in  
2 claim 2, wherein Fe or Co are replaced by at least one  
3 element selected from the group consisting of Al, Mo, Zr,  
4 Ti, Sn, Cu, Ga and Nb, a summed amount of the at least one  
5 element being 0.1 to 3 atom% of a total amount of the Nd-  
6 Fe-B type rare earth magnet alloy.

1 7. The Nd-Fe-B type rare earth magnet alloy as claimed in  
2 claim 1, wherein the Nd-Fe-B type rare earth magnet alloy  
3 is a thin strip crystalline alloy produced by a strip  
4 casting method.

1 8. The Nd-Fe-B type rare earth magnet alloy as claimed in  
2 claim 7, wherein a thickness of the thin strip alloy is  
3 within a range from 30 to 300  $\mu\text{m}$ .

1 9. Powder of a Nd-Fe-B type rare earth magnet alloy  
2 comprising:  
3 hard magnetic phases and soft magnetic phases,  
4 wherein a minimum width of the soft magnetic phases is  
5 smaller than or equal to 1  $\mu\text{m}$  and a minimum distance  
6 between the soft magnetic phases is greater than or equal  
7 to 0.1  $\mu\text{m}$ .

1 10. The powder as claimed in claim 9, wherein the powder  
2 is produced by pulverizing the Nd-Fe-B type rare earth  
3 magnet alloy by means of a ball mill.

1 11. The powder as claimed in claim 9, wherein the powder  
2 is heat treated within a range from 500 to 800  $^{\circ}\text{C}$ .

1 12. A method of producing powder of a Nd-Fe-B type rare  
2 earth magnet alloy which comprises hard magnetic phases and  
3 soft magnetic phases wherein a minimum width of the soft  
4 magnetic phases is smaller than or equal to 1  $\mu\text{m}$  and a  
5 minimum distance between the soft magnetic phases is  
6 greater than or equal to 0.1  $\mu\text{m}$ , the method comprising:

7           pulverizing the Nd-Fe-B type rare earth magnet alloy  
8   by means of a ball mill using a dispersant under a  
9   non-oxidation atmosphere.

1   13.   The method as claimed in claim 12, wherein the ball  
2   mill is of a wet type.

1   14.   The method as claimed in claim 12, wherein the ball  
2   mill is of a dry type.

1   15.   A method of producing a Nd-Fe-B type anisotropic  
2   exchange spring magnet, comprising:

3           obtaining powder of a Nd-Fe-B type rare earth magnet  
4   alloy which comprises hard magnetic phases and soft  
5   magnetic phases wherein a minimum width of the soft  
6   magnetic phases is smaller than or equal to 1  $\mu\text{m}$  and a  
7   minimum distance between the soft magnetic phases is  
8   greater than or equal to 0.1  $\mu\text{m}$ ;

9           obtaining a compressed powder body by compressing the  
10   powder at a compressing pressure ranging from 1 to 5  
11   ton/cm<sup>2</sup> in a magnetic field ranging from 15 to 25 kOe; and

12           obtaining a bulk magnet by sintering the compressed  
13   powder body at a temperature ranging from 600 to 800 °C and  
14   at a compressing pressure ranging from 1 to 10 ton/cm<sup>2</sup> in a  
15   discharge plasma sintering unit.

1   16.   The method as claimed in claim 15, wherein the powder  
2   is obtained by pulverizing the Nd-Fe-B type rare earth  
3   magnet alloy by means of a ball mill.

1   17.   A Nd-Fe-B type anisotropic exchange spring magnet  
2   produced by a method of obtaining powder of a Nd-Fe-B type

3 rare earth magnet alloy which comprises hard magnetic  
4 phases and soft magnetic phases wherein a minimum width of  
5 the soft magnetic phases is smaller than or equal to 1  $\mu\text{m}$   
6 and a minimum distance between the soft magnetic phases is  
7 greater than or equal to 0.1  $\mu\text{m}$ ; obtaining a compressed  
8 powder body by compressing the powder at a compressing  
9 pressure ranging from 1 to 5  $\text{ton/cm}^2$  in a magnetic field  
10 ranging from 15 to 25 kOe; and obtaining a bulk magnet by  
11 sintering the compressed powder body at a temperature  
12 ranging from 600 to 800  $^{\circ}\text{C}$  and at a compressing pressure  
13 ranging from 1 to 10  $\text{ton/cm}^2$  in a discharge plasma  
14 sintering unit.

1 18. The Nd-Fe-B type anisotropic exchange spring magnet as  
2 claimed in claim 17, wherein a density of the anisotropy  
3 exchange spring magnet is 95% of a true density of a magnet  
4 alloy having a composition as same as that of the  
5 anisotropic exchange spring magnet.

1 19. A motor comprising:  
2 a Nd-Fe-B type anisotropic exchange spring magnet  
3 produced by a method of obtaining powder of a Nd-Fe-B type  
4 rare earth magnet alloy which comprises hard magnetic  
5 phases and soft magnetic phases wherein a minimum width of  
6 the soft magnetic phases is smaller than or equal to 1  $\mu\text{m}$   
7 and a minimum distance between the soft magnetic phases is  
8 greater than or equal to 0.1  $\mu\text{m}$ , obtaining a compressed  
9 powder body by compressing the powder at a compressing  
10 pressure ranging from 1 to 5  $\text{ton/cm}^2$  in a magnetic field  
11 ranging from 15 to 25 kOe, and obtaining a bulk magnet by  
12 sintering the compressed powder body at a temperature

- 13 ranging from 600 to 800 °C and at a compressing pressure
- 14 ranging from 1 to 10 ton/cm<sup>2</sup> in a discharge plasma
- 15 sintering unit.